

water has soon become foul, and the whole contents of the tank, both animal and vegetable, have rapidly suffered, and it has required some time before the water could be restored to its former healthy condition.

In one of the numbers of the 'Zoologist' of last year, I stated that besides the *Ulvæ*, *Enteromorpha* and *Cladophora*, I had found the *Zostera marina* a very useful plant for oxygenating the sea water; but this observation has reference only to the case of a tank supplied with a ground where its roots will find a sufficiency of food for its growth, as in a clear shingle or sand it soon decays; and it should be associated with such animals as delight in a ground of this nature, as many of the Annelids, Crabs, burrowing Shrimps, &c. There are several interesting observations which have been made from time to time connected with this subject, which I hope to lay before the natural-history world as soon as I can find leisure time for the purpose.

Apothecaries' Hall, Sept. 10, 1853.

XXXI.—On the Cornbrash of the neighbourhood of Cirencester.

By JAMES BUCKMAN, F.L.S., F.G.S., Professor of Geology Royal Agricultural College*.

THE Cornbrash as it occurs in the neighbourhood of Cirencester, though for the most part a very thin member of the Oolitic series of rocks, yet presents us with many points for consideration of great interest.

In the counties of Gloucester and Wilts it is always found to rest upon a thick bed of Forest marble clay, a section at Kemble, four miles from Cirencester, being as follows in descending order:—

	ft.	in.
1. Cornbrash, an oolitic stone, with rough uneven fracture and full of shells	8	0
2. Blue clay without shells } Forest	17	0
Siliceous limestone ... } marble	6	0
4. Bradford clay, very fossiliferous	7	0
5. Great Oolite		

The bed No. 1, which it is our object to describe in the following remarks, though of so slight thickness, is found to be the substratum of large tracts of land, especially in the neighbourhood of Cirencester, Fairford, Cricklade, and Malmsbury; in each case presenting great and beneficial peculiarities of soil, not only when compared with that upon its surrounding forest marble, but also in comparison with other oolitic brashes; indeed, its name "Cornbrash" would appear to have been given to it from the fact that its soil affords a brash or stony soil

* Read to the Cotteswold Naturalists' Club, Sept. 20, 1853.

favourable for corn crops, which is far from usually being the case with those either of the Inferior or Great Oolitic beds; indeed our observations of crops upon what the Cotteswold farmer calls "stone brashes" of the district, when compared with the Cornbrash, would lead us to conclude the following as a fair average grown upon an acre in bushels:—

	1. Stonebrash, Inferior Oolite.	2. Stonebrash, Great Oolite.	3. Cornbrash.
	Bushels.	Bushels.	Bushels.
Wheat	15 to 20	20 to 25	25 to 30
Barley.....	25 to 30	30 to 35	40 to 45
Oats	25 to 30	35 to 40	45 to 50

The average rent may perhaps be gathered from the following table:—

	the acre.
1. Stonebrash, Inferior Oolite	7s. to 20s.
2. Stonebrash, Great Oolite.....	14s. to 25s.
3. Cornbrash.....	20s. to 40s.

This great difference in the productive powers of soils, which a cursory examination only would lead to the conclusion were nearly alike in character, may, to a considerable extent, be explained by the following analyses, which were made by Professor Voelcker from specimens which I had the pleasure of procuring for him; and it may be remarked in passing, that as the analyses were made by the Professor in order to ascertain the different constituents of the rocks and not the soil, in each case typical hand specimens were presented to him, and the result singularly explains observed facts with regard to the crops upon the respective substrata.

Result of analyses by Professor A. Voelcker:—

	Inferior Oolite.	Great Oolite.	Cornbrash.
Carbonate of lime	89·20	95·346	89·195
Magnesia	·34	·739	·771
Sulphate of lime	·09	·204	·241
Oxide of iron			
Alumina	4·14	1·422	2·978
Phosphoric acid	·06	·124	·177
Soluble silica	2·75	1·016	1·231
Insoluble siliceous matter...	3·27	·533	4·827
Alkaline salts	undetermined.	undetermined.	undetermined.
	99·85	99·384	99·420

These analyses show that the phosphoric acid and sulphate of lime—two important chemical agents in the growth of crops—greatly predominate in the Cornbrash; and besides this, the thickness of Cornbrash soil is always greater than that upon the Stonebrashes, as this rock more readily breaks up and becomes disintegrated by atmospheric action.

These remarks tend to show the great practical advantage of geological and chemical knowledge, and fully explain how a successful farmer near Cirencester has converted a “brash farm” —which is in general a term of reproach—into one of the most productive farms in the district, this brash being the fertile Cornbrash.

But not only is this thin stratum of interest on account of the fine crops which it yields, but it will ever present a charm to the geologist from the rich harvest of fossils which it everywhere contains; indeed, the reason why it crumbles down so readily is probably owing in part to its being composed of shells, which are merely cemented together by a calcareous matrix, whilst the phosphates of the rocks are doubtless derived from its imbedded animal matter; hence our examination has not only afforded a tolerable list of species, but several forms are numerically so great, and offer so many curious types, as to deserve a more attentive study than has yet been accorded them. Now in giving an account of the fossil contents of the Cornbrash, it must be understood that my facts are solely derived from observation in the quarries of my more immediate district and are consequently incomplete, and as a lengthened list of fossils could only be the more tedious the more copious its details, I propose in this place to append a mere summary of its remains, making remarks upon its more interesting palæontological features.

*Summary of Cornbrash Fossils from the neighbourhood of
Cirencester.*

	Species.
1. Brachiopoda	7
2. Conchifera	30
3. Gasteropoda	10
4. Cephalopoda	3
5. Annelida	4
6. Zoophyta	3
7. Echinodermata.....	8

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65

An interesting feature in the natural history of the Brachiopoda, is that five forms of *Terebratulina*, namely the *T. lagenalis*, *sublagenalis*, *obovata*, *ornithocephala*, and *digona* of authors (see Davidson's memoir on Oolitic Brachiopoda by the Palæontogra-

phic Society), are all referable to one species; this is a fact arrived at by a comparison of hundreds of individuals, and that the author just cited seems to have almost arrived at when he says, in his description of *T. lagenalis*, "This species has little to distinguish it from *T. ornithocephala*, into which it seems to merge by insensible passages," p. 42. As regards *T. sublagenalis*, the same author remarks, "This species is always accompanied by *T. lagenalis*, of which it may perhaps only be a variety," p. 43; and further, "It is not difficult to find species uniting *ornithocephala* to *lagenalis*, and this last to *sublagenalis*; but as the typical shapes of each are well distinguishable, it will be found convenient to retain them under distinct specific names." The *Terebratula digona*, he says, "often approaches in general form and convexity certain specimens of *T. obovata*."

Here then a wide subject for discussion seems to be opened up; for if we are to found specific names upon *typical* specimens, the question is, where are we to stop? certainly in the case before us, not with five species. And again, if we admit the specific identity of the five types under discussion, is it not probable that even these are but derivative forms that may, in like manner, be identified with others? Our own materials certainly tend to this conclusion.

In this district the five forms quoted, though not altogether, yet for the most part, affect distinct localities; hence the *T. lagenalis* and *sublagenalis* will be found congregated in masses in the Fairford quarries, while the *T. obovata*, from being a rare exception with them, becomes the rule between Cirencester and Cricklade. All these, however, are at Malmsbury replaced by the *T. digona*, which, as yet, is the only instance in this district in which I have observed the latter shell straying from the Bradford Clay, of which I have been used to consider it characteristic.

The only remaining Brachiopod I shall here mention will be the *T. intermedia*, 'Min. Conch.' t. 15. f. 8: this is undoubtedly, to say the least, a form of *T. perovalis*. This opinion again is borne out by Mr. Davidson, as he says in his Memoir, p. 53, "*Ter. intermedia* bears some resemblance to *T. perovalis*; some specimens are undistinguishable." Now as this latter is an abundant fossil of the Inferior Oolite as well as Cornbrash, the sequel will show its recurrence to be of great interest.

Our next remarks will be upon the Conchifera, the chief interest of which will be found in the fact, that in our summary of fifty species, twenty-one or nearly half can be identified with Inferior Oolite shells, and those for the most part of individuals which have always been held as highly characteristic of the Lower Oolite beds; this will become apparent from the following

List of Fossils common to the Inferior Oolite and Cornbrash of Gloucestershire.

- | | |
|--|---|
| 1. Amphidesma securiforme, Phill. York. (<i>Gresslya</i> .) | 12. Modiola gibbosa, M. C. |
| 2. ——— decurtatum, Phill. York. | 13. ——— plicata, M. C. |
| 3. ——— recurvum, Phill. York. | 14. Mya literata, M. C. |
| 4. Astarte excavata. | 15. Ostrea, undetermined (perhaps several species). |
| 5. Avicula inæqualis, M. C. | 16. Pholadomya Murchisonæ, M. C. t. 545. |
| 6. Cardium citrinoideum, Phill. York. | 17. ——— gibbosa. |
| 7. ——— dissimile, M. C. | 18. Plagiostoma duplicatum. |
| 8. ———, undetermined. | 19. Pecten. |
| 9. Isocardia concentrica. (<i>Ceromya</i> .) | 20. Trigonia costata. |
| 10. ——— minima. | 21. ——— clavellata. |
| 11. Lima gibbosa, M. C. 491. | |

Here then we have evidence of an older fauna reappearing in force in a newer bed, and that bed of a very insignificant thickness; these facts, while they should make us cautious in assigning limits to the range of fossils, may at the same time account for much of the confusion felt in the history of the Oolites of Britain, which only becomes the greater on comparison with the "*Jurassique*" of the continent.

These remarks are the more pertinent, when it is understood that in Phillips's '*Illustrations of the Geology of Yorkshire*,' nearly all, if not every individual species figured as characteristic of the Cornbrash are amongst the more common examples of Inferior Oolite fossils.

Now these species, except in a few instances, are not common alike to the Great Oolite of this district, but a reference to Morris and Lycett's '*Monograph of the Mollusca of the Great Oolite, chiefly from Minchinhampton and the coast of Yorkshire*,' will tend to explain how the parallelism of the Inferior Oolite and Cornbrash species of this district could be maintained by the Great Oolite of the more northerly oolitic deposits. In the introduction to the memoir cited, p. 6, are the following remarks:—"The evidence afforded by the few species of univalves which have been forwarded to the authors from Scarborough, through the kindness of Mr. Bean, though not conclusive, tends rather to assimilate them with the Inferior Oolite, and the authors are led to the following very satisfactory explanation. Admitting therefore the parallelism of the deposits containing somewhat distinct faunas in the north-eastern and south-western parts of the present area of England, we are naturally led to infer, either that the physical conditions might be favourable to the continuation of species in one locality, or that species characteristic of an older deposit, in a more distant region, may have migrated and lived on during the formation of a newer de-

posit in another, the conditions having become unfavourable to the perpetuity of their development in the latter deposit over the original region whence they had migrated.”

There is now only one other part of our summary of fossils which seems to claim attention, and that is the Echinodermata. Of these at least six out of eight are common to the Inferior Oolite, namely—

- | | |
|------------------------|--------------------------------|
| Nucleolites = Clypeus. | Holactypus = Galerites. |
| 1. — sinuatus. | 4. — depressus. |
| 2. — clunicularis. | 5. Acrosolenia hemicidaroides. |
| 3. — orbicularis. | 6. Diadema depressum. |

Of these the *Nucleolites sinuatus* and *Holactypus depressus* are highly characteristic of the Inferior Oolite.

In concluding these remarks, it should be understood that they refer only to a limited district. Were our observations extended over the whole range of the Cornbrash, as it occurs in this country, we should doubtless arrive at additional facts, both as regards the structure and agricultural capabilities and also its fossil contents: we may indeed expect the list of the latter to be greatly augmented, and in all probability other species common to the Inferior Oolite will have to be noted in addition to those in our present list.

XXXII.—On the Teeth of the *Pneumonobranchiate Mollusca.*

By J. E. GRAY, Ph.D., F.R.S., V.P.Z.S. &c.

THE teeth of the *Pneumonobranchiate Mollusca* are exceedingly uniform, when this group is confined to those which have a closed pulmonary cavity, which, in my former arrangement, I called *Adelopneumona*; I now think that the genera which form the other suborder, being unisexual, and having many characters, as well as the structure of the tongue, like those of the *Teniglossa*, should be arranged with them, near to the *Littorinidæ*, which often pass the greater part of their lives out of water, and have very imperfectly developed gills on the inside of the mantle.

All the genera of the order so restricted have very numerous, nearly similar ctenoglossal teeth, placed in many cross lines on a more or less elongated lingual band.

In some genera the line is straight, in others angularly diverging from the central lines, and in some the series are angularly bent on each side of the central line.

Professor Troschel, who has figured the teeth of some European